

Amendments to the Specification

Amend paragraph [0001] as follows:

[0001] The present invention relates to a method for mounting a flap on a workpiece, wherein the flap is positioned precisely with respect to a reference area on the workpiece, ~~according to the preamble of patent claim 1,~~ as disclosed, for example, in EP 470 939 A1. Furthermore, the present invention relates to a device for carrying out this method.

Add the following new heading before paragraph [0002]:

BACKGROUND

Add the following new heading before paragraph [0008]:

SUMMARY OF THE INVENTION

Delete paragraph [0009].

Amend paragraph [0010] as follows:

[0010] In order to position and attach the flap to the vehicle body, a robot-guided gripping tool is used which comprises a securing device for the flap and a sensor system which is fixedly ~~permanently~~ connected to the gripping tool. The securing device of the gripping tool is equipped with a flap and is firstly placed, under control by a robot, in a proximity position (for which there is permanent programming and which is independent of the current position of the vehicle body in the working space of the robot) with respect to the vehicle body. The gripping tool is then moved by means of a closed-loop control process to a mounting position in which the flap which is held in the securing device is oriented in a precisely positioned fashion in the desired "optimum" installation position with respect to the adjacent areas on the vehicle body. In this closed-loop control process, in which the gripping tool is moved from the proximity position into the mounting position, (actual) measured values from selected reference areas on the vehicle

body and on the flap are generated by the sensor system; these (actual) measured values are compared with (setpoint) measured values which have been generated in a preceding setup phase. The gripping tool is then moved by an amount equal to a movement vector (comprising linear movements and/or rotations), which vector is calculated from the difference between the (actual) and (setpoint) measured values using what is referred to as a "Jacobi matrix" (or "sensitivity matrix"). Both the (setpoint) measured values and the Jacobi matrix are determined within the scope of a setup phase which occurs before the actual positioning and mounting process, within the scope of which setup phase the gripping tool is trained to the specific mounting task. This setup phase is run through once in the course of the setting up of a new combination of tool, sensor system, type of vehicle body and type and installation position of the flap to be used.

Amend paragraph [0011] as follows:

[0011] Once the closed-loop control process described above has been completed and the flap which is held in the gripping tool is thus in the desired mounting position with respect to the vehicle body, the next method step starts, in the course of which the flap is mounted on the vehicle body. During this step, the predefined mounting program is run through under the control of a robot, and other robot-guided tools (for example welding robots, screwing robots, feed devices for attachment elements ...) are also involved apart from the gripping tool. ~~The essential fact here is that during~~ During the processing of the mounting program the mounting position which is discovered in the course of the positioning process and is arranged in a precisely positioned fashion with respect to the vehicle body is used as a reference position for all the further tools and working steps involved in the mounting process.

Amend paragraph [0012] as follows:

[0012] The positioning process which is run through in a closed-loop controlled fashion and in the scope of which the flap which is held in the gripping tool is moved from the proximity position (moved into under control by a robot) into the mounting position (oriented in a precisely positioned fashion with respect to the vehicle body), differs basically from the positioning process which is known from EP 470 939 A1: in the method in EP 470 939 A1 the absolute position of the vehicle body (or of the door opening) in the working space of the robot is firstly

in fact determined in the course of the positioning process and then forms the basis for the orientation of the equipped gripping tool. In contrast to this, the method according to the invention is based on relative measurements, within the scope of which information (stored in the setup phase) is restored using ~~by means of~~ the closed-loop control process, said information corresponding to a set of (setpoint) measured values of the sensor system.

Amend paragraph [0020] as follows:

[0020] The attachment elements (hinges, joints, ...) through ~~by means of~~ which the flap is connected to the vehicle body can be part of the flap to be mounted so that these attachment elements only have to be connected to the workpiece in this mounting position after the above-described positioning of the flap in the opening in the vehicle body has ended. However, in many cases hinges which are firstly attached to the vehicle body before the flap is coupled to the hinges are used for connecting flaps to vehicle bodies. In this case it is advantageous to carry out the mounting of the hinges on the vehicle body in the same working step as the mounting of the flap. In this case, the mounting method advantageously comprises the following process steps:

Add the following new heading before paragraph [0033]:

BRIEF DESCRIPTION OF THE DRAWINGS

Amend paragraph [0033] as follows:

[0033] ~~Further advantageous embodiments of the invention can be found in the~~
~~subclaims.~~ The invention is explained in more detail below with reference to an exemplary embodiment which is illustrated in the drawings, in which:

Add the following new heading before paragraph [0040]:

DETAILED DESCRIPTION

Amend paragraph [0041] as follows:

[0041] The rear door 3 is mounted in the vehicle body 1 using an automatic mounting system 4 (illustrated schematically in figure 1) with a working space 27. The mounting system 4 comprises a gripping tool 5 which is guided by an industrial robot 7 and which feeds the rear door 3 and positions it precisely with respect to the vehicle body 1. Furthermore, the mounting system 4 comprises a hinge mounting system 6 which is guided by an industrial robot 8 and which feeds hinges to the vehicle body 1, orients them with respect to the vehicle body 1 and the precisely positioned door and attaches them to a hinge joining area 39 (Fig. 4) in the door opening 2. A control system 10 is provided for controlling the position and movement of the robots 7, 8 and thus of the tools 5, 6.

Amend paragraph [0043] as follows:

[0043] In order to mount the rear door 3 in the door opening 2, the hinges 9 are firstly attached in the hinge joining areas 39 of the door opening 2, and the rear door 3 is then fastened to the hinges 9 in the defined position. The position in which the hinges 9 are attached in the door opening 2 determines the position of the completely-mounted rear door 3 in the door opening 2 ~~in a decisive way here~~. In order to ensure a high-quality visual impression of the vehicle body 1, the rear door 3 must be mounted in a precisely positioned fashion (in terms of position and angular attitude) with respect to the areas 11 of the vehicle body 1 which are adjacent to the door opening 2; the surrounding areas 11 thus form what is referred to as a reference area for the orientation of the rear door 3 with respect to the vehicle body 1.

Amend paragraph [0046] as follows:

[0046] ~~The~~ As shown in Figs. 3 and 5, the hinge mounting system 6 is attached to the hand 21 of the second industrial robot 8 and comprises two hinge tension jacks 22 in which the two hinges 9, which are necessary for attaching the door 3 in the door opening 3, are held in a defined precisely positioned and precisely angled orientation (see figure 3). Furthermore, the hinge mounting system 6 comprises robot-controlled dynamometric screwdrivers (not shown in figure 3) for attaching the hinges 9 in the door opening 2 in the vehicle body 1. The hinge tension jacks 22 are configured in such a way, and arranged with respect to the screwdrivers, in such a way that the screwing faces 23 at which the hinges 9 are connected to the vehicle body 1 are accessible to the screwdrivers. The hinges 9 are inserted (automatically or manually) into the

receptacles 22, with the possibility of the attachment screws (not shown in figure 3) with which the hinges 9 are attached to the vehicle body 1 being inserted or supplied later automatically, together with the hinges 9.

Amend paragraph [0047] as follows:

[0047] The hinge mounting system 6 is also provided with a sensor system 24 which comprises a plurality of sensors 25 (~~2~~ two in the schematic illustration in figure 3) which form one structural unit with the hinge mounting system 6. These sensors 25 are used, as described later, for positioning the hinge mounting system 6 with respect to the gripper tool 5.